



MBT-4000B

Multi-Band Transceiver System Installation and Operation Manual

IMPORTANT NOTE: The information contained in this document supersedes all previously published information regarding this product. Product specifications are subject to change without prior notice.



MBT-4000B

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Multi-Band Transceiver System Installation and Operation Manual

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ABOUT THIS MANUAL

This manual provides installation and operation information for the Comtech EF Data MBT-4000B, Multi-Band Transceiver System. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the MBT-4000B, Multi-Band Transceiver System.

CONVENTIONS AND REFERENCES

CAUTIONS AND WARNINGS



Indicates information critical for proper equipment function.



Indicates a hazardous situation that, if not avoided, may result in minor or moderate injury. CAUTION may also be used to indicate other unsafe practices or risks of property damage.



Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

METRIC CONVERSION

Metric conversion information is located on the inside back cover of this manual. This information is provided to assist the operator in cross-referencing non-Metric to Metric conversions.

TRADEMARKS

All product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

RECOMMENDED STANDARD DESIGNATIONS

Recommended Standard (RS) Designations are equivalent to the designation of the Electronic Industries Association (EIA). Reference to only one designator is used in the document.

REPORTING COMMENTS OR SUGGESTIONS CONCERNING THIS MANUAL

Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the Comtech EF Data Customer Support Department.

EMC COMPLIANCE

This is a Class A product. In a domestic environment, it may cause radio interference that requires the user to take adequate protection measures.

EN55022 COMPLIANCE

This equipment meets the radio disturbance characteristic specifications for information technology equipment as defined in EN55022.

EN50082-1 COMPLIANCE

This equipment meets the electromagnetic compatibility/generic immunity standard as defined in EN50082-1.

FEDERAL COMMUNICATIONS COMMISSION (FCC)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction manual, it may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference; in which case, users are required to correct the interference at their own expense.

Note: To ensure compliance, properly shielded cables for DATA I/O shall be used. More specifically, these cables shall be shielded from end to end, ensuring a continuous shield.

SAFETY COMPLIANCE

EN 60950

Applicable testing is routinely performed as a condition of manufacturing on all units to ensure compliance with safety requirements of EN60950.

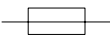
This equipment meets the Safety of Information Technology Equipment specification as defined in EN60950.

LOW VOLTAGE DIRECTIVE (LVD)

The following information is applicable for the European Low Voltage Directive (EN60950):

<HAR>	Type of power cord required for use in the European Community.
	CAUTION: Double-pole/Neutral Fusing. ACHTUNG: Zweipolige bzw. Neutraleiter-Sicherung.

International Symbols:

Symbol	Definition
	Alternating Current.
	Fuse.

Symbol	Definition
	Protective Earth.
	Chassis Ground.

Note: For additional symbols, refer to “Cautions” listed earlier in this preface.

WARRANTY POLICY

This Comtech EF Data product is warranted against defects in material and workmanship for a period of 2 years from the date of shipment. During the warranty period, Comtech EF Data will, at its option, repair or replace products that prove to be defective.

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LIMITATIONS OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper installation or maintenance, abuse, unauthorized modification, or operation outside of environmental specifications for the product, or, for damages that occur due to improper repackaging of equipment for return to Comtech EF Data.

No other warranty is expressed or implied. Comtech EF Data specifically disclaims the implied warranties of merchantability and fitness for particular purpose.

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Comtech EF Data has reviewed this manual thoroughly to provide an easy-to-use guide to your equipment. All statements, technical information, and recommendations in this manual and in any guides or related documents are believed reliable, but the accuracy and completeness thereof are not guaranteed or warranted, and they are not intended to be, nor should they be understood to be, representations or warranties concerning the products described. Further, Comtech EF Data reserves the right to make changes in the specifications of the products described in this manual at any time without notice and without obligation to notify any person of such changes.

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tpubs@comtechefdata.com

Chapter 1. Introduction



Figure 1-1. MBT-4000B Outdoor Multi-Band RF Transceiver

1.1 OVERVIEW

This manual provides instructions on the installation, operation and maintenance of the MBT-4000B, Multi-Band Transceiver System (MBT-4000B), manufactured by Comtech EF Data (CEFD). Specifications for this model are included in this section.

1.2 FUNCTIONAL DESCRIPTION

The MBT-4000B is designed to perform the following functions:

- LNB support for C-, X-, or Ku- RF to L-Band down conversion
- L-Band to C-, X-, or Ku- RF up conversion
- RF Band switching in minimal time without requiring tools
- Easy expansion for providing a redundant system or other frequency bands
- System status verification via LEDs located behind a removable cover

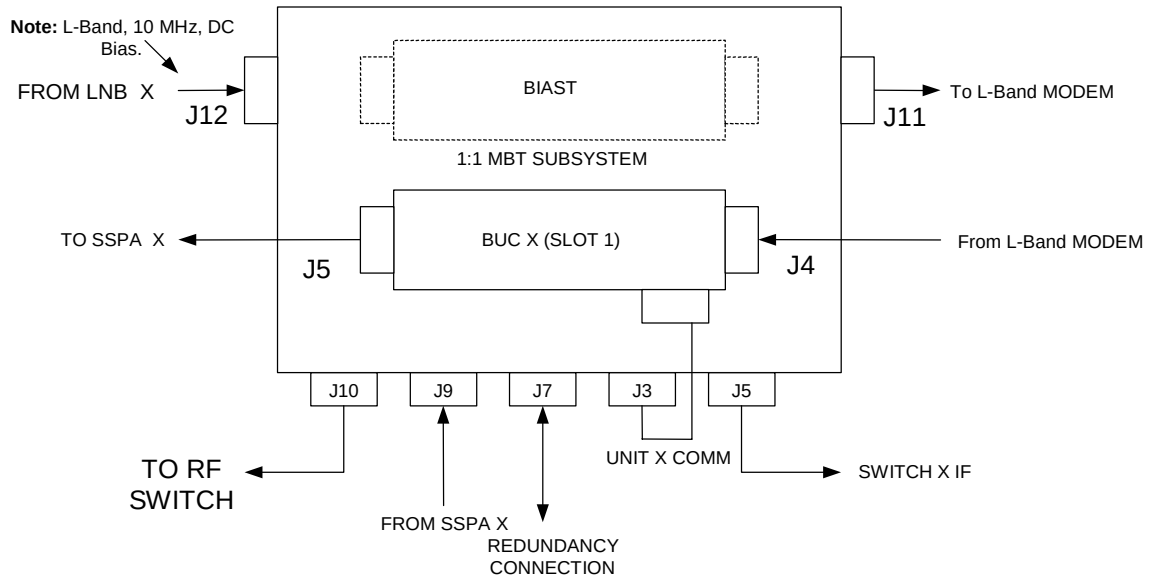


Figure 1-2. MBT-4000B Typical Application

1.3 SPECIFICATIONS

1.3.1 SUMMARY OF SPECIFICATIONS

BUC-4000 ODU Characteristics	Specifications	BUC-4000 ODU Characteristics	Specification
Input Frequency Range	950–2000 MHz, 125 kHz steps (1 kHz optional)	Environmental:	
Output Freq By Model:		Operating Temperature	-40° to +50° C
BUC-4000C	5850-6650 MHz	ODU: BUC-4000	(-40° to 122°F)
BUC-4000X	7900-8400 MHz		
BUC-4000Ku	13.75-14.50 GHz		
BUC-4000Ka	30.00-31.00 GHz		
	27.50-28.50 GHz (optional)		
	28.50-29.50 GHz (optional)		
	29.50-30.10 GHz (optional)		
Input/Output Impedance	50 Ω	Operating Altitude	10,000 feet above sea level
Input Return Loss	15 dB minimum	Operating Humidity	5 to 95%, non-condensing
Output Return Loss	18 dB minimum	Non-Operating Temperature	-50° to + 75°C (58° to +160°F)
Input Connector	Type 'N' – Female	Physical:	
Output Connector	Type 'N' – Female (C, X, and Ku)	ODU: MBT-4000B	
Gain	15 dB nominal at minimum attenuation	Prime Power	90 to 260 VAC, 47 to 63 Hz
User Attenuation Range	0 to 10 dB	Size	Refer to Figure 1-3.
Output Power, P1dB	+10 dBm minimum		
Third Order Intercept	+20 dBm minimum		
Carrier Spurious	-60 dBc		
Non-Carrier Spurious	-60 dBm		
External Reference	Input, either 5 to 10 MHz $\pm$ 5 dBm optional		

1.3.2 DIMENSIONAL ENVELOPE

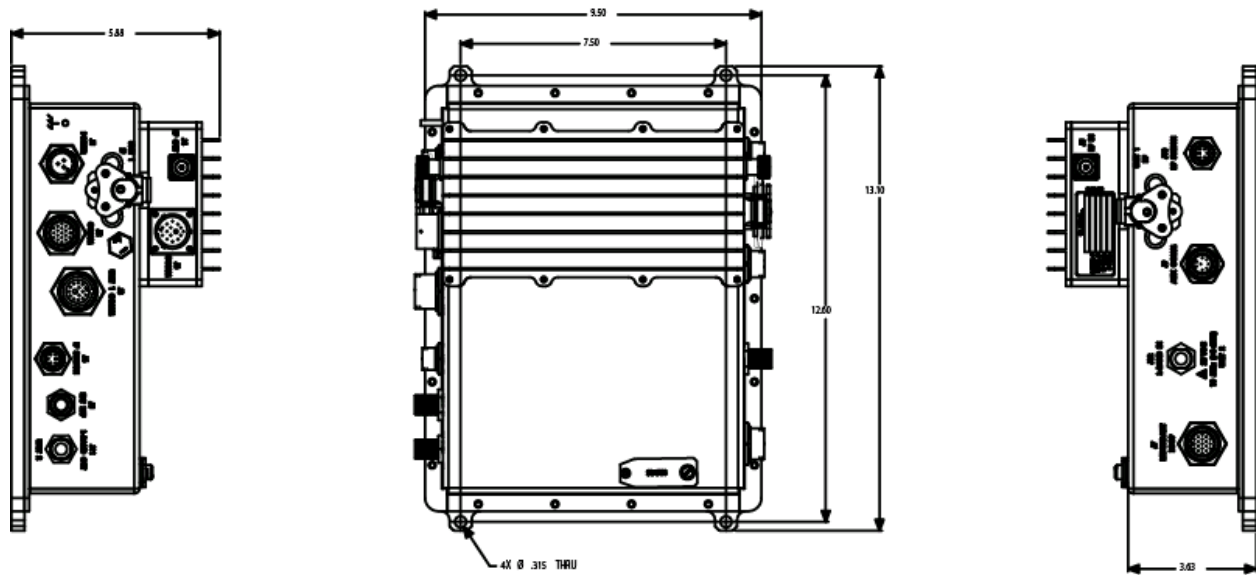
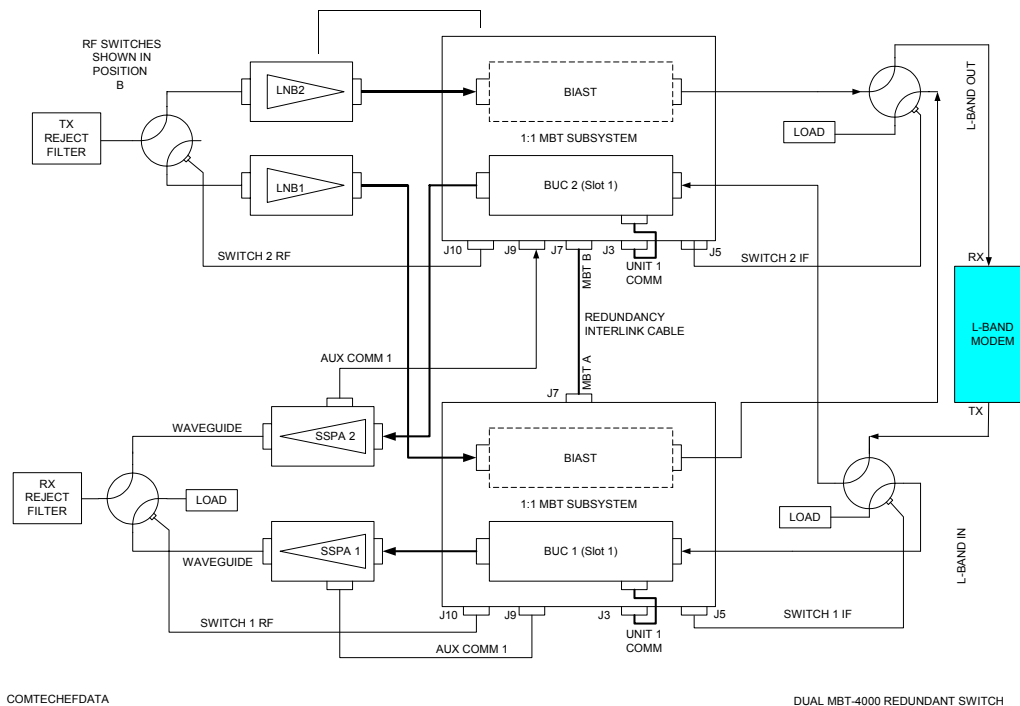


Figure 1-3. MBT-4000B Dimensional Envelope

1.3 SYSTEM OVERVIEW

The transceiver is constructed in a modular configuration. Common to the configuration for any frequency band of operation is a base module, which provides the M&C, Power Supply, and Reference function. A Band-specific BUC module is mounted to the base module with clip-type fasteners. An internal bias tee provides a 10 MHz reference and bias voltage for an external LNB.



Note: 1:2 splitters/combiners may be substituted for the L-Band Input/Output switches.

Figure 1-4. Typical, Chain Switched, Redundant Diagram

NOTES:

Chapter 2. Installation

2.1 UNPACKING AND INSPECTION

Inspect shipping container for damage. If shipping containers are damaged, keep them until contents of shipment have been carefully inspected and checked for normal operation.

Remove the packing list from the outside of the shipping carton. Open the carton and remove the contents, checking the contents against the packing list. Verify completeness of the shipment and that the unit functions correctly. If damage is evident, contact the carrier and Comtech EF Data immediately and submit a damage report. If the unit needs to be returned to Comtech EF Data, use the original shipping container.

2.2 INSTALLATION AND OPERATION

The Common Module of the MBT-4000B may be located near or on the antenna. The band-specific BUC is latched into place on top of the Common Module (M&C, Power Supply, Reference). Cables to the antenna and IDU complete the installation.

Table 2-1. PWR IN (J1) Pin Connections

Pin	PWR IN (J1)
A	LINE
B	NEUTRAL
C	GND
	Mating Connectors: ITT Cannon KPT06B-12-3S CEFD PN CN/MS-STPG03F02

2.2.1 COMM (J2) PIN CONNECTIONS

Table 2-2. COMM (J2) Pin Connections

Pin	COMM (J2)
A	RS 485 Rx+
B	RS 485 Rx-
C	RS 485 Tx+
D	RS 485 Tx-
E	RS 232 RD
F	NC
G	RS 232 TD
H	NC
J	NC
K	SUM FLT COMM
L	SUM FLT NO
M	SUM FLT NC
N	NC
P	NC
R	NC
S	NC
T	GND
U	GND
V	NC
	Mating Connectors: Cannon MS3116J14-19P CEFD CN/MS3116J14-19P

2.2.2 IF SWITCH (J4) PIN CONNECTIONS

Table 2-3. IF Switch (J4) Pin Connections

Pin	IF Switch (J4)
A	POS 1 IF
B	GND
C	POS 2 IF
D	POS 1 IND IF
E	GND
F	POS 2 IND IF
	Mating Connectors: Cannon MS3116J10-6P CEFD CN/MS3116J10-6P

2.2.3 REDUNDANT LOOP (J7) PIN CONNECTIONS

Table 2-4. Redundant Loop (J7) Pin Connections

Pin	Redundant Loop (J7)
A	SW POS 2 DRIVE OUT
B	GND
C	SW POS 2 DRIVE OUT
D	RF SW IND OUT
E	IF SW IND OUT
F	SW POS 1 DRIVE IN
G	SW POS 2 DRIVE IN
H	RF SW IND IN
J	IF SW IND IN
K	MBT A IND
L	MBT B IND
M	NC
N	BXC 1 FLT OUT
P	BXC 2 FLT OUT
R	BXC 1 FLT IN
S	BXC 2 FLT IN
T	NC
U	TX
V	RX
	Mating Connectors: CEFD CA/WR11224 Redundant Loop Cable

2.2.4 Aux Comm 1 (J9) PIN CONNECTIONS

Table 2-5. Aux Comm 1 (J9) Pin Connections

Pin	AUX COMM1 (J9)
A	AUX Rx + A
B	AUX Rx – A
C	AUX Tx + A
D	AUX Tx – A
E	+12.6V LNA A
F	IO1 A/Fault see Note 1
G	IO1 B see Note 2
H	GND
	Mating Connectors: Canon MS3116J12-8P CN/MS3116J12-8P

Notes:

1. Input from external amplifier.
2. Normally, an Input, when programmed as an output, this pin indicates Online/Offline status of Unit 1.

2.2.5 RF SWITCH (J10) PIN CONNECTIONS

Table 2-6. RF Switch (J10) Pin Connections

Pin	RF SWITCH (J10)
A	POS 1 RF
B	GND
C	POS 2 RF
D	POS 1 IND RF
E	GND
F	POS 2 IND RF
	Mating Connectors: MS3116J10-6P CN/MS3116J10-6P

NOTES:

Chapter 3. System Operation

3.1 DESCRIPTION

The MBT 4000B supports LNBs for receive down conversion. It outputs +17VDC nominal and 10 MHz on the “L-Band input” connector. The LNB amplifies the input RF signal and down converts it to L-Band in the range of 950 to 1750 MHz (there may be instances that the L-Band range = 950 to 1450 MHz). The choice of which downlink frequency band is determined by the selection of a frequency range, usually from one of LNBs in the following bands:

For C-Band	For Ku-Band
3.625 to 4.2 GHz	10.95 to 11.70 GHz
4.50 to 4.80 GHz	11.70 to 12.20 GHz
	12.25 to 12.75 GHz



LNBs are available that are either externally referenced (EXT REF) or internally referenced (INT REF). DC power is supplied to the LNB through the IFL cable from the MBT 4000B for both types.

The standard LNB noise temperature is: For C-Band < 35°K.
 For Ku- Band < 65°K.

3.2 BLOCK UP CONVERTER (BUC-4000)

The BUC-4000 translates an L-Band carrier to the desired output frequency (C, X-, or Ku- or Ka-), with an output level capable of driving an HPA.

BUC-4000 C, X, Ku, Ka

Band	Frequency	LO Frequency	Inverting
C-Band	5850 to 6650 MHz	4900 MHz	No
X-Band	7900 to 8400 MHz	6950 MHz	No
Ku-Band-W	13.75 to 14.50 GHz	12.800 GHz	No
Ka-Band	30.00 to 31.00 GHz		

Notes:

1. No spectral inversion
2. 10 dB gain adjustment.

3.3 LO, MIX AND SPECTRUM SETTINGS (LNB)

3.3.1 C-BAND

Table 3-1. For C-Band: LO and MIX Information for Demodulator and LNB

LNB Part No.	Description	LO (Offset) Frequency (MHz)	MIX (+/-)	Min LNB Satellite Frequency (MHz)	Max LNB Satellite Frequency (MHz)	L-Band Frequency At LNB Min (MHz)	L-Band Frequency At LNB Max (MHz)	Demod Spectrum (Utility Demod Menu)	Operating Voltage, V	RF Connector
RF/LNB-C-55-35N	3.625 – 4.200 GHz Ext Ref	5,150.00	-	3,625.00	4,200.00	1,525.00	950.00	Invert	18	Type N
RF/LNB3.6-4.2FE	3.625 – 4.200 GHz Ext Ref	5,150.00	-	3,625.00	4,200.00	1,525.00	950.00	Invert	18	Type F
RF/LNB3.6-4.2F03	3.625 – 4.200 GHz Ext Ref	5,150.00	-	3,625.00	4,200.00	1,525.00	950.00	Invert	18	Type F
XXXXXXXXXXXXXX	3.400 – 4.200 GHz	5,150.00	-	3,400.00	4,200.00	1,525.00	950.00	Invert	18	Type F
XXXXXXXXXXXXXX	4.500 – 4.800 GHz	5,760.00	-	4,500.00	4,500.00	1,525.00	950.00	Invert	18	Type F

3.3.2 KU-BAND

Table 3-2. For Ku-Band: LO and MIX Information for Demodulator and LNB, Ku-Band

LNB Part No.	Description	LO (Offset) Frequency (MHz)	MIX (+/-)	Min LNB Satellite Frequency (MHz)	Max LNB Satellite Frequency (MHz)	L-Band Frequency At LNB Min (MHz)	L-Band Frequency At LNB Max (MHz)	Demod Spectrum (Utility Demod Menu)	Operating Voltage, V	RF Connector
RF/LNB-10.9-11.7FE	10.95 – 11.7 GHz Ext Ref	10,000.00	+	10,950.00	11,700.00	950.00	1700.00	Normal	18	Type F
RF/LNB-11.7-12.2FE	11.7 – 12.2 GHz Ext Ref	10,750.00	+	11,700.00	12,200.00	950.00	1450.00	Normal	18	Type F
RF/LNB-12.2-12.7FE	12.25 - 12.75 GHz Ext Ref	11,300.00	+	12,250.00	12,750.00	950.00	1450.00	Normal	18	Type F
RF/LNB-10.9-11.7F03	10.95 – 11.7 GHz ± 3 ppm	10,000.00	+	11,200.00	11,700.00	950.00	1450.00	Normal	18	Type F
RF/LNB-11.7-12.2F03	11.7 – 12.2 GHz ± 3 ppm	10,750.00	+	10,950.00	11,700.00	950.00	1700.00	Normal	18	Type F
RF/LNB-12.2-12.7F03	12.25 - 12.75 GHz ± 3 ppm	11,300.00	+	12,250.00	12,750.00	950.00	1450.00	Normal	18	Type F

Chapter 4. Redundant Configuration

4.1 General

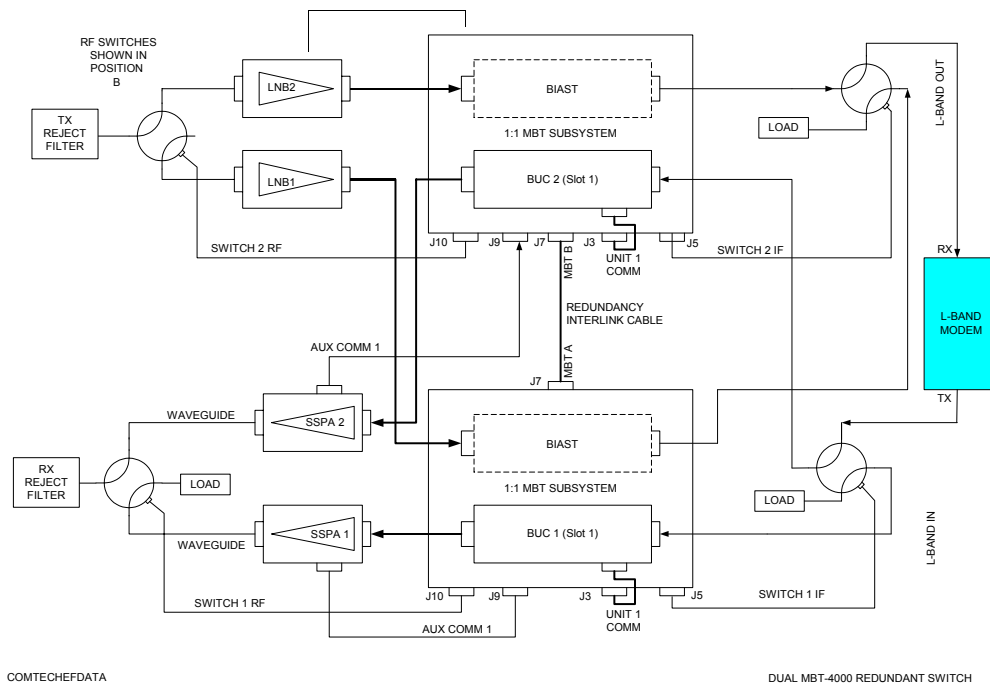
The MBT-4000B is designed to operate in both stand-alone and redundant configurations. Every MBT-4000B base contains the circuitry and logic necessary to perform all the functions of a backup controller in either a single base and dual base configuration. The Bias Tee side of the MBT 4000B provides the 10 MHz reference and DC voltage for the LNB. This power supply features current monitoring with programmable failure limits. Overcurrent and undercurrent failures can participate in overall fault indication and redundant switchover criteria.

Each MBT-4000B base includes one “AUX COMM” connector. This connector includes a logic input intended to be connected to contact closure fault indications of external equipment. Thus, external equipment failure may participate in overall fault indication and redundant switchover operation. The “AUX COMM” connector also has a user programmable I/O pin. When programmed as an output, this pin indicates the online/offline position of the switch associated with the BUC. This signal can be used to mute the external offline amplifier.

Each MBT-4000B base includes two “switch drive” connectors. Each of these connectors is intended for driving and monitoring a 28V latching switch. In most installations, one switch drive connector will drive an RF waveguide switch, while the second switch drive connector will drive an IF(L-Band) co-axial switch.

4.2 Dual Base (Chain) Redundancy Operation

Refer to Figure 4-1 of typical Dual Base (Chain) Redundancy configuration.



Note: 1:2 splitters/combiners may be substituted for the L-Band Input/Output switches.

Figure 4-1. Dual Base (Chain) Redundancy Operation

The two base units cooperate in monitoring the health of the two BUCs, two external amplifiers, two LNBs, and each other. In case of a fault on an on-line BUC/amplifier or LNB, the base containing the corresponding standby chain will automatically switch over to the standby chain according to the following rules:

Step	Procedures
1	In dual base (chain) redundancy operation, the redundancy is 'slot' based. The corresponding pairs reside in the same 'slot' of the opposite MBT-4000B base, the pair of BUCs connected to J3 UNIT 1 COMM (slot 1) on each base form a redundant pair. The LNBs connected to "L BAND IN" on each base form the other redundant pair.
2	The corresponding BUCs in a pair must be of the same type.
3	The redundancy interlink cable (P/N: CA/WR11224-1 or equivalent), must be installed.
4	Base unit identification (MBT A or MBT B) is driven by the redundancy interlink cable. Hard-wired connections within the cable designate one MBT-4000B base as MBT-A and the other as MBT-B. The cable is labeled accordingly.
5	The RF and IF switches connected to MBT-A correspond to the redundant pair of BUCs installed on J3 UNIT 1 COMM (slot 1).
6	The RF and IF switches connected to MBT-B correspond to the redundant pair of LNBs installed on the "L Band In" connectors.
7	When a BUC or LNB attached to MBT-A is on-line, the corresponding RF and IF switches will be switched to position A. When a BUC or LNB attached to MBT-B is on-line, the corresponding switches will be switched to position B.

For a switchover to occur:

- Both MBT-4000B base units must be set to redundancy mode 2, the RED=2 command must have been received by each base.
- Both chains must be set to automatic mode. For example, if the redundant pair is on Slot 2 of the bases, the command RAM=21 must have been received by each base.
- The corresponding standby chain must not be in faulted state.

4.3 External Fault Monitoring

Each MBT-4000B base includes a logic input, on the AUX COMM connector, that may be connected to contact closure fault indications of external equipment (usually an SSPA or TWTA). Thus, external equipment failure may participate in overall fault indication and redundant switchover operation according to the following rules:

Step	Procedures
1	An open connection (or 2.7 V min) indicates a fault condition exists.
2	A closed connection (or 0.7 V max) indicates no fault condition exists.
3	Maximum voltage range on fault logic inputs is –12V to +12V.
4	The fault input of AUX COM 1 corresponds to the BUC installed as UNIT 1.
5	To enable fault input checking the EAM=1m command is used. The mode parameter 'm' can equal 0 for disabled, or 1 for enabled

4.4 LNB Power Supply Current Monitoring

The bias tee in the MBT-4000B base is used to supply power and the 10 MHz reference to the LNB.

This power supply features current monitoring with programmable failure limits. Over-current and under-current failures can participate in overall fault indication and redundant switchover criteria.

The following commands and rules configure operation of this feature.

Step	Procedures
1	The power supply provides +18V with a 450 mA current limit.
2	The bias tee supply is controlled by issuing the 'LCS=2m' command as follows: a. "m" is the mode. Valid values are 0=OFF or 1=ON.
3	In case of excessive current (more than 450 mA), the supply will be disabled and a fault will be posted. The 'LCS=2m' command must be sent again to re-enable the supply.
4	To enable programmable current monitoring, the following steps are taken: a. The desired output is enabled as outlined above. b. The nominal current is calibrated using the CLC=2 command. c. The programmable current window is specified using the LCW=2xx command. Where 'xx' is the allowable percentage of variance from nominal (set by the CLC command). Acceptable values for 'xx' are 20 to 50 in increments of 1%. In addition, a value of '99' for 'xx' disables the alarm function. d. If a current is detected outside this window, a LNB current fault will be posted, but the supply will not be disabled.

4.5 Gain Equalization of Redundant Units

Uplink Gain equalization in an MBT-4000B system is accomplished by issuing individual attenuation settings to the specific BUCs.

4.6 LED Status Indicators

The two LED indicators reflect the status of the MBT-4000B as follows:

For the Online status:

Steady GREEN	No faults present and the unit is not muted.
Steady YELLOW	No faults present and the unit is muted.
Steady RED	The unit is faulted.

For the Offline status:

Blinking GREEN	No faults present, the unit is not muted.
Blinking YELLOW	No faults present, the unit is muted.
Blinking RED	The unit is faulted.

4.7 Redundant Systems Check

Step	Procedure
1	Set up two MBTs with BUCs installed in slot one. Note: The BUCs must match.
2	Using a multi-drop 485 connection, set the comm. address of one MBT to one(<"current address"/SPA=0001) and the comm. address of the other MBT to two(<"current address"/SPA=0002).
3	With both MBTs connected to a multi-drop 485 connection, use the RET command to verify communication and software versions on all bases and MBTs.
4	Power the system down.
5	Connect the redundant loop cable (CA/WR11224-1) between the two MBT base units.
6	Connect switches to the RF Switch connector on both base units. Note the "A" and "B" labels on the end of the redundant loop cable. The MBT base connected to the "A" end of the cable will be connected to the switch associated with the uplink(BUC/SSPA) path and will be referred to as "MBT A". The MBT connected to the end of the cable labeled "B" will be connected to the switch associated with the downlink(LNB) and will be referred to as "MBT B".
7	Power up system.
8	Enable two unit redundancy by sending RED=2 to both base units.
9	Place redundancy in AUTO mode by sending RAM=11 and RAM=21 to both base units.
10	Verify that there are two "solid" LEDs and two "flashing" LEDs. The "solid" LEDs indicate the "online" slots. The "flashing" LEDs indicate the offline slots.
11	Send MUT=0 to all blocks(<1A1/MUT=0, <2A1/MUT=0) This should unmute the BUCs. Unmute the bias tee by sending an MSP=0 to both base units(<1/MSP=0, <2/MSP=0)
12	Verify that all LEDs are green, with two flashing.
13	Power down MBT B. This should force both switches to select MBT A.

Step	Procedure
14	Verify that both LEDs on MBT A are solid green.
15	Power up MBT B
16	Verify that both LEDs on MBT B are flashing green.
17	Power down MBT A.
18	This should have forced both switches to throw to MBT B.
19	Verify that both LEDs on MBT B are solid green
20	Power up MBT A.
21	Verify that both LEDs on MBT A are flashing green.

Uplink Test

- 22 Fault the block in slot 1 of MBT B by disconnecting the base-to-BUC cable.
- 23 LED 1 on MBT B should now be flashing red.
- 24 This should have forced the switch connected to MBT A to throw.
- 25 Verify that LED 1 on MBT A is solid green.
- 27 Clear the fault on unit 1 of MBT B by reconnecting the base-to-BUC cable.
- 28 Verify that LED 1 on MBT B is now flashing green.
- 29 Fault the block in slot one of MBT B and confirm proper switch/LED behavior.
- 30 If the system is being used to monitor external SSPAs to provide chain switching, perform the following. Otherwise, continue to the "Downlink Test".
- 31 Build the two cables(one per MBT/SSPA) that interface the AUX COMM 1 connector of the MBT to the amplifiers discrete control connector.

Items to note:

1. The MBT is designed to pass 485 communications directly to the amplifier. Pins A-D are hard wired to the 485 comm. bus coming into the MBT. If the amplifier is going to share the same 485 bus, it will need to have its own serial comm. address.
 2. Pin F of the AUX comm. connector is used to monitor the summary fault relay of the amplifier. This line is internally pulled up and must be grounded to clear a fault condition. MBT serial command "EAM=11" allows this fault to be detected and acted upon by the MBT.
 3. Pin G of the AUX comm. connector provides a logic level ONLINE/OFFLINE indication. This can be used to force an offline amplifier to be muted. The amplifier must have a discrete mute-status control line. This pin is set to be an output using the "EOM=10" (letter O) command. The logic state associated with an online/offline position can be set using the "IOM=21" or "IOM=20" command
- 32 Connect the cable between the amplifiers and the AUX Comm. one connectors on the base units. Terminate the output of the amplifiers and power them up

Step	Procedure
33	Enable external fault monitoring by sending an EAM=11 command to both base units.
34	Fault the online SSPA by removing its power and confirm LED one of the associate MBT is red(indicates fault detected" and blinking(indicates the switch has thrown and is now offline). Restore the system and repeat for the second amplifier.
35	If the online/offline control line(Pin G of the Aux comm. connector) is being used, proper operation can be established by querying the amplifiers mute status. The line must be enabled as an output using the "EOM-1O" command. If the logic levels are opposite of what is required, the "IOM=1X" command can be used.
36	Setting the BUC attenuators independently performs gain balancing. If the BUC/amplifier chain associated with MBT A has 1 dB more gain then the chain associated with MBT B, add one dB of attenuation to the desired setting of the BUC on MBT A.

Downlink Test

- 37 Ensure redundancy is enabled and set to AUTO mode as outlined above
- 38 Connect the LNBs
- 39 Enable the LNB voltage by sending "LCS=21" to both base units.
- 40 Verify the LNBs are drawing appropriate current by polling the with an "RMS?" query. Reported current for "LNA2" should be in the 200 to 400 mA range.
- 41 Calibrate the normal operating point of the LNB by sending "CLC=2" to both base units. This records the operating current of the LNB and the MBT will monitor this current.
- 42 Set the desired current window(outside of which a fault will be declared) using the "LCW=2XX" command. Note the "XX" is the percentage of the nominal current allowed before a fault is declared. 30%(LCW=230) is a typical setting.
- 43 Disconnect the online LNB(indicated by the solid unit two LED). The LED should now turn red and blink and the LNB switch should throw. The unit 2 LED on the other MBT should stop blinking
- 44 Restore the first LNB and fault the second. The same change in LEDs and switch position should be observed.

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Appendix A. Remote Control

This section describes the protocol and message command set for remote monitor and control of the MBT 4000B.

The electrical interface is either an RS-485 multi-drop bus (for the control of many devices) or an RS-232 connection (for the control of a single device), and data is transmitted in asynchronous serial form, using ASCII characters. Control and status information is transmitted in packets, of variable length, in accordance with the structure and protocol defined in later sections.

A.1 RS-485

For applications where multiple devices are to be monitored and controlled, a full-duplex (or 4-wire) RS-485 is preferred. Half-duplex (2-wire) RS-485 is possible, but is not preferred.

In full-duplex RS-485 communication, there are two separate, isolated, independent, differential-mode twisted pairs, each handling serial data in different directions. It is assumed that there is a 'controller' device (a PC or dumb terminal), which transmits data, in a broadcast mode, via one of the pairs. Many 'target' devices are connected to this pair, which all simultaneously receive data from the controller. The controller is the only device with a line-driver connected to this pair - the target devices only have line-receivers connected.

In the other direction, on the other pair, each target has a tri-stateable line driver connected, and the controller has a line-receiver connected. All the line drivers are held in high-impedance mode until one target transmits back to the controller.

Each target has a unique address, and each time the controller transmits, in a framed 'packet' of data, the address of the intended recipient target is included. All of the targets receive the packet, but only the intended one will reply. The target enables its output line driver, and transmits its return data packet back to the controller, in the other direction, on the physically separate pair.

RS-485 (full duplex) summary:

Two differential pairs

one pair for controller to target

one pair for target to controller

Controller-to-target pair

one line driver (controller) and all targets have line-receivers.

Target-to-controller pair

one line receiver (controller) and all targets have tri-state drivers.

A.2 RS-232

This is a much simpler configuration in which the controller device is connected directly to the target via a two-wire-plus-ground connection. Controller-to-target data is carried, via RS-232 electrical levels, on one conductor, and target-to-controller data is carried in the other direction on the other conductor.

A.3 BASIC PROTOCOL

Whether in RS-232 or RS-485 mode, all data is transmitted as asynchronous serial characters, suitable for transmission and reception by a UART. The asynchronous character format is fixed at 8 data bits, no parity, and 1 stop bit. Only two (2) baud rates are supported: 9600 baud and 19200 baud.

All data is transmitted in framed packets. The host controller is assumed to be a PC or ASCII dumb terminal, which is in-charge of the process of monitor and control. The controller is the only device that is permitted to initiate, at will, the transmission of data. Targets are only permitted to transmit when they have been specifically instructed to do so by the controller.

All bytes within a packet are printable ASCII characters, less than ASCII code 127. In this context, the Carriage Return and Line Feed characters are considered printable.

All messages from controller to target require a response (with one exception). This will be either to return data that has been requested by the controller, or to acknowledge reception of an instruction to change the configuration of the target. The exception to this is when the controller broadcasts a message (such as Set time/date) using Address 0, when the target is set to RS-485 mode.

A.4 PACKET STRUCTURE

Controller-to-Target:

Start of Packet	Target Address	Address De-limiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
< ASCII code 60 (1 character)	(4 or 6 characters)	/ ASCII code 47 (1 character)	(3 characters)	= or ? ASCII code 61 or 63 (1 character)	(n characters)	Carriage Return ASCII code 13 (1 character)

Example: <0412/MUT=1 {CR}

Target-to-Controller:

Start of Packet	Target Address	Address De-limiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
> ASCII code 62 (1 character)	(4 or 6 characters)	/ ASCII code 47 (1 character)	(3 characters)	=, ?, !, or * ASCII code 61, 63, 33 or 42 (1 character)	(From 0 to n characters)	Carriage Return, Line Feed ASCII code 13,10 (2 characters)

Example: >0412/MUT={CR} {LF}

Each of the components of the packet is now explained.

A.4.1 START OF PACKET

Controller to Target: This is the character '<' (ASCII code 60)

Target to Controller: This is the character '>' (ASCII code 62)

Because this is used to provide a reliable indication of the start of packet, these two characters may not appear anywhere else within the body of the message.

A.4.2 ADDRESS

Up to 9999 devices can be uniquely addressed. In both RS-232 and RS-485 applications, the permissible range of values is 1 to 9999. It is programmed into a target unit using the remote control port.

The BDC and BUC sub-devices may also be addressed by appending the corresponding sub-device address. The sub-device address is 'A1' for the BXC.

For example, a mute command addressed to a BUC attached to an MBT-4000B at address 0412 will be:

<0412A1/MUT=1 {CR}

The format of the response will be:

>0412A1/MUT={CR} {LF}

Sub-device addresses cannot be changed.



The controller sends a packet with the address of a target - the destination of the packet. When the target responds, the address used is the same address, to indicate to the controller the source of the packet. The controller does not have its own address.

A.4.3 INSTRUCTION CODE

This is a three-character alphabetic sequence that identifies the subject of the message. Wherever possible, the instruction codes have been chosen to have some significance. This aids in the readability of the message, should it be displayed in its raw ASCII form. Upper case and lower case alphabetic characters may be used (A-Z, and a-z).

A.4.4 INSTRUCTION CODE QUALIFIER

This single character further qualifies the preceding instruction code.

Code Qualifiers obey the following rules:

1. From Controller-to-Target, the only permitted values are:
= (ASCII code 61)
? (ASCII code 63)

They have these meanings:

The '=' code (controller to target) is used as the assignment operator, and is used to indicate that the parameter defined by the preceding byte should be set to the value of the argument(s) which follow it.

For example, in a message from controller to target, MUT=1 would mean 'enable the mute function'.

The '?' code (controller to target) is used as the query operator, and is used to indicate that the target should return the current value of the parameter defined by the preceding byte.

For example, in a message from controller to target, MUT? would mean 'return the current state of the mute function'

2. From Target-to-Controller, the only permitted values are:
= (ASCII code 61)
? (ASCII code 63)
! (ASCII code 33)
* (ASCII code 42)
(ASCII code 35)

They have these meanings:

The '=' code (target to controller) is used in two ways:

First, if the controller has sent a query code to a target (for example MUT?, meaning 'is mute enable or disable?'), then the target would respond with MUT=x, where x represents the state in question, 1 being 'enable' and 0 being disable.

Second, if the controller sends an instruction to set a parameter to a particular value, and providing the value sent in the argument is valid, then the target will acknowledge the message by replying with MUT= (with no message arguments).

The '?' code (target to controller) is only used as follows:

If the controller sends an instruction to set a parameter to a particular value, and if the value sent in the argument is not valid, then the target will acknowledge the message by replying (for example) with MUT? (with no message arguments). This indicates that there was an error in the message sent by the controller.

The '' code (target to controller) is only used as follows:*

If the controller sends an instruction to set a parameter to a particular value, and if the value sent in the argument is valid, however, the target is in the wrong mode (e.g., standby mode in redundancy configuration) that it will not permit that particular parameter to be changed at that time, then the target will acknowledge the message by replying (for example) with MUT* (with no message arguments).

The '!' code (target to controller) is only used as follows:

If the controller sends an instruction code which the target does not recognize, then the target will acknowledge the message by echoing the invalid instruction, followed by the ! character. Example: XYZ!

The '#' code (target to controller) is only used as follows:

If the controller sends an instruction code which the target cannot currently perform because of hardware resource issues, then the target will acknowledge the message by echoing the invalid instruction, followed by the # character.

A.4.5 MESSAGE ARGUMENTS

Arguments are not required for all messages. Arguments are ASCII codes for the characters 0 to 9 (ASCII 48 to 57), period (ASCII 46) and comma (ASCII 44).

A.4.6 END OF PACKET

Controller to Target: This is the 'Carriage Return' character (ASCII code 13).

Target to Controller: This is the two-character sequence 'Carriage Return', 'Line Feed'. (ASCII code 13, and code 10.)

Both indicate the valid termination of a packet.

A.5 REMOTE COMMANDS

A	E	L	R	X
AFR, A-9	EAM, A-15	LCM, A-16	RAI, A-21	XRF, A-28
ATT, A-9	EOM, A-24	LCS, A-16	RAM, A-21	
		LCW, A-16	RAS, A-22	
		LFL, A-16	RCS, A-23	
		LNA, A-18	RED, A-24	
			REF, A-24	
			RET, A-24	
			RMS, A-25	
			RSN, A-26	
			RUS, A-26	
C	F	M	S	
CAA, A-9	FRE, A-16	MUT, A-18	SBR, A-26	
CAI, A-10	FRW, A-16	MSP, A-19	SFS, A-26	
CAS, A-10			SPA, A-26	
CCS, A-11			SSA, A-27	
CID, A-11			SSW, A-27	
CLC, A-11				
CMS, A-14				
CUS, A-15				
D	I	O	T	
DAT, A-15	IOM, A-24	ONL, A-20	TIM, A-27	
			TNA, A-28	
			TSA, A-28	

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Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Automatic Fault Recovery State	AFR=x	All	1 byte, value of 0, 1	Command or Query. Enable Automatic Fault Recovery on a BXC as follows: 0=Disabled 1=Enabled Example: AFR=1	AFR=(message ok) AFR? (received ok, but invalid arguments found) AFR*(message ok, but not permitted in current mode)	AFR?	AFR=x (same format as command arguments)
Attenuation	ATT=xx.xx	BDC BUC	5 bytes, numeric	Command or Query Valid attenuation level, in dB, at 0.25dB step size as factory default. Example: ATT=08.25	ATT=(message ok) ATT? (received ok, but invalid arguments found) ATT*(message ok, but not permitted in current mode) ATT! (Command not accepted by MBT-4000B base unit. It must be addressed to BUC or BDC sub-units)		
Clear All Stored Alarms	CAA=	All	None	Command only. Instructs the slave to clear all Stored Events. This command takes no arguments.	CAA=(message ok)	N/A	N/A

Parameter Type	Command (Instruction Code and Qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (Target to controller)	Query (Instruction Code and qualifier)	Response to query (Target to controller)
Concise AUX COMM I/O	N/A	MBT	n=Slot 1=AUX COMM 1	Query only. Used to Query the Concise AUX COMM I/O of the MBT-4000B base unit, where n=1 Where: n=1(AUX COMM 1) Example: <0001/CAI?n{cr} >0001?CAI=nabcd{cr}{lf} Where: n=1 (AUX COMM) a=12V (0=Off, 1=On) b=IOA (0=logic low [voltage input < 0.5], 1=logic high [voltage input > 2.7 vdc]) c=IOB (0=logic low [voltage input < 0.5], 1=logic high [voltage input >2.7 vdc]) d=Reserved (Always zero)	CAI=(message ok) CAI? (received ok, but invalid arguments found) CAI*(message ok, but not permitted in current mode)	CAI?n	CAI=nabcd (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Concise Alarm Status	N/A	All	20 bytes, numeric	Query only. Used to query the alarm status of the unit. Example: <0001/CAS?{cr} >0001/CAS=abcdefghijkl{cr}{lf} where: a through l = 0 or 1, 0=OK, 1=FLT All: a=+15V Power Supply b=+7.5V Power Supply c=+5.0V Power Supply MBT-4000B: d=+28V Power Supply e=Ref Oscillator Lock Detect f=Intermodule Communications g=Max current on LNA power supply AUX COMM1 h=Max current on LNB power supply Bias Tee i=Current window LNA power supply AUX COMM1 j=Current window LNB power supply Bias Tee k=Fault input AUX COMM1 (Pin F, J9) l=Not used BDC/BUC: d=X (reserved for future use) e=Synthesizer Lock Detect f=Heat-sink Temperature g=LNA current (BDC only, reserved on BUC) h=Reserved, always zero i-l=Not sent.	N/A	CAS?	CAS=x...X (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Concise Configuration Status	N/A	All	48 bytes (BDC) 41 bytes (BUC) 32 bytes (MBT) alphanumeric	Query only. Returns the summarized version of RCS. Example for MBT-04000 base unit: <pre><0001/CCS?{cr} >0001/CCS=aa,bb,cc,dd,e,ff,g,h{cr}{lf}</pre> Where: aa=Frequency band for Unit 1 BXC ('C', 'X', 'Ka', 'Ku', or 'NA') bb=NA cc=Direction for Unit 1 BXC ('DN'=BDC, 'UP'=BUC, 'NA'=None) dd=NA e=Redundancy mode (0, 1, or 2) ff=Automatic mode g=Redundancy loop cable address N=No Cable A=MBT-A B=MBT-B h=External reference lock (1=locked, 0=Not locked) Example BDC or BUC: <pre><0001A1/CCS?{cr}{lf} >0001A1/CCS=aaaaa,bb.bb,c,d.d,e,ff,g,hhhh,i,j,{CR}{lf}</pre> Where: aaaaa=Frequency in MHz bb.bb=Attenuation in dB c=mute state, 0=unmuted, 1=muted d.d=slope adjust e=LNA current source (BDC only, BUC=X) ff=LNA current window (BDC only, BUC=XX) g=LNA fault logic (BDC only, BUC=X) hhhh=XXXX (reserved for future use) i=X (reserved for future use) j=Fault recovery, 0=Manual, 1=Auto	N/A	CCS?	CCS=x....x (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Circuit Identification	CID=	All	24 bytes, alphanumeric	Command or Query. Used to identify or name the unit or station. First line is limited to 24 characters. Example: CID={cr} -Earth Station 1-- ---Converter #1---	CID=(message ok) CID?(received ok, but invalid arguments found)	CID?	CID=x...x (see description for details of arguments)
Calibrate LNA Current	CLC=s	MBT BDC	S=1 byte Value of 1, 2 1=LNA A 2= LNB bias tee	Command only. This command is used to set the calibration point for the LNA /LNB current alarm feature. Source 1=LNA A (AUX COMM1) 2=LNB Bias Tee Example: CLC=2 would record the current measured for the LNB bias tee	CLC=(message ok) CLC?(received ok, but invalid arguments found) CLC*(message ok, but not permitted in current mode) CLC!(command not accepted by BUC or BDC sub-units.)	N/A	N/A

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Concise Maintenance Status	N/A	All	40 bytes alphanumeric	Query only. Used to query the maintenance status of the unit in concise format. Response is comma delimited as follows: Example: <0001/CMS?{cr} >0001/CMS=aaa.a,bbb.b,ccc.c,ddd.d,eee.e,fff.f,ggg.g,h,i,j,k{cr} {lf} All: aaa.a=+15V power supply bbb.b=+7.5V power supply ccc.=+5V power supply MBT-4000B Base Unit: ddd.d=+28V power supply eee.e=Ref oscillator tuning voltage fff.f=LNA current in mA for LNA A (AUX COMM1) ggg.g= LNB current in mA for the bias tee h=local RF switch position (A, B, or N) i=Local IF switch position (A, B, or N) j=Remote RF switch position (A or B) k=Remote IF switch position (A or B) Note: 1. It is not possible to detect the absence of a remote switch. 2. N= Not present. BDC: ddd.d=XXX.X (reserved for future use) eee.e=Synthesizer tuning voltage fff.f=LNA current in mA. ggg.g= Unit temperature in °C. h – k= Not present BUC: ddd.d=XXX.X (reserved for future use) eee.e=Synthesizer tuning voltage fff.f=RF output power in dBm (reserved) ggg.g=Unit temperature in °C h – k= Not present	N/A	CMS?	CMS=... (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Concise Utility Status	N/A	MBT	21 bytes alphanumeric	Query only. Used to query the utility status of the MBT-4000 Base Unit, response is comma delimited. Where: aaaa=Physical Address bbbb=Remote Baud Rate Example: <0001/CUS? >0001/CUS=aaaa,bbbb{cr}{lf}	N/A	CUS?	CUS=x...x (see description for details of arguments)
Set RTC (Real-Time-Clock) Date	DAT=mmddyy	All	6 bytes, numeric	Command or Query. A command in the form mmddyy where; dd = day of the month, between 01 and 31 mm = month of the year, between 01 and 12 yy = year, between 00 and 96 (2000 to 2096) Example: DAT=042503 would be April 24, 2003.	DAT= (message ok) DAT? (received ok, but invalid arguments found) DAT* (message ok, but not permitted in current mode)	DAT?	DAT=mmddyy (same format as command arguments)
Enable Aux Com Fault Input Monitoring	EAM=nm	MBT	n=1 AUX COMM1 m=0 (disabled), 1 (monitoring enabled)	Command or Query. EAM controls monitoring of external fault logic inputs to Aux Comm connectors (J9 pin F). If enabled and external fault input is at Logic 1 (> 2.6 vdc) a fault will be reported. This fault is reported has the LNA I1 or LNA I2 status in the RAS? Query. Note: The inputs may be driven by a contact closure relay. They have an internal pull-up resistor (4.7k) to +5 vdc. Example: EAM=11	EAM=(message ok) EAM?(received ok, but invalid arguments found)	EAM?n	EAM=nm (same format as command arguments)

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Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Retrieve next 5 unread Stored Alarms	N/A	All	145 bytes	Query only The unit returns the oldest 5 Stored Events, which have not yet been read over the remote control. Reply format: Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body, where Sub-body=YYYYYYYYYY ZZ hhmmss mmddyy Where: YYYYYYYYYY=being the fault description. ZZ= being the alarm type. FT = Fault OK = Clear IF = Information If there are no new events, the unit will reply with LNA* Note: See Appendix B for a description of possible Alarm/Events that may be found in the Alarm queue.	N/A	LNA?	LNA=YY..ss (see description for details of arguments)
Mute State	MUT=x	BDC BUC	1 byte, value of 0,1	Command or Query. Mute the unit, where: 0 = Disabled, 1 = Enabled Example: MUT=1	MUT= (message ok) MUT? (received ok, but invalid arguments found) MUT* (message ok, but not permitted in current mode) MUT! (command not accepted by MBT-4000B base unit. It must be addressed to BUC or BDC sub-units)	MUT?	MUT=x (same format as command arguments)

Bias Tee Mute State	MSP=x	MBT	1 byte, value of 0,1	Command or Query. Mute the unit, where: 0 = Disabled, 1 = Enabled Example: MSP=1 would mute the LNB bias tee	MSP= (message ok) MSP? (received ok, but invalid arguments found) MSP* (message ok, but not permitted in current mode) MSP! (Command not accepted by BUC or BDC sub-units. It must be addressed to the MBT-4000B base unit)	MSP?	MSP=x (same format as command arguments)
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Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Online Status	N/A	All	N/A	Query only. Used to query the online status of the unit (useful in redundant configurations). Return position of corresponding RF switch. Example for MBT-4000B base unit: <0001/ONL?{cr} >0001/ONL={cr}{lf} ON1=ON ,{cr} ON2=ON , {cr}{lf} Example for BDC: <0001A1/ONL?{cr} >0001A1/ONL=1{cr}{lf} Example for BUC: <0001A2/ONL?{cr} >0001A2/ONL=1{cr}{lf}	ONL= (message ok) ONL? (received ok, but invalid arguments found)	ONL?	ONL=x

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Retrieve AUX COMM I/O	N/A	MBT	1 byte, value of n=1 1=Aux Comm1	Query only. Used to Retrieve AUX COMM I/O of the MBT-4000B base unit., where n=1 where: n=1 (Aux Comm 1) Example: <0001/RAI?1 Returns: >0001/RAI= 12V1=On IO1A=0 IO1B=1 RSVD=0 Note: 0 = Logic low or input voltage < 0.5 vdc. 1 = Logic level 1 or input voltage > 2.7 vdc.	RAI = (message ok) RAI? (received ok, but invalid arguments found) RAI* (message ok, but not permitted in current mode)	RAI?n	RAI=x....x (see description for details of arguments)
Redundancy Mode	RAM=um	MBT	u=1 byte, value of 1, 2 1=Unit 1 2=Unit 2 m=1 byte, Value of 0, 1 0 = Manual 1 = Automatic	Command or Query. Sets redundancy mode as follows: Unit Mode 1=Unit 1 0 = Manual 2=Unit 2 1 = Automatic Example: RAM=11	RAM= (message ok) RAM? (received ok, but invalid arguments found) RAM* (message ok, but not permitted in current mode)	RAM?u u=1 byte, Value of 1, 2	RAM=um (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Retrieve Alarm Status	N/A	All	92 bytes MBT-4000B 64 bytes (BUC), 74 bytes (BDC), alphanumeric	Query only. Used to Query the Alarm status of the unit Example for MBT-4000B base: <pre><0001/RAS?{cr} >0001/RAS={cr} 15VT1=OK{cr} 7V5T1=OK{cr} 5VLT1=OK{cr} 28VT1=OK{cr} REFLD=OK{cr} IICST=OK{cr} LNAC1=OK{cr} (Note 2) LNAC2=OK{cr} (Note 2) LNAW1=OK{cr} (Note 3) LNAW2=OK{cr} (Note 3) LNAI1=OK{cr} (Note 4) LNAI2=OK{cr}{lf} (Note 5)</pre> Example for BDC or BUC: <pre><0001A1/RAS?{cr} >0001A1/RAS={cr} 15VLT=OK{cr} 7V5LT=OK{cr} 5VOLT=OK{cr} REFLD=XX {cr} (reserved for future use) SYNLD=OK{cr} HSTMP=OK{cr} LNACR=OK{cr}{lf}</pre> Notes: 1. LNACR will only appear for BDC. 2. FT reported if MAX current exceeded. 3. FT reported if LCW window current exceeded. 4. FT reported if EAM = 11 & Pin F of J9 High. 5. FT reported if EAM = 21 & Pin F of J8 High, not applicable to MBT-4000B.	N/A	RAS?	RAS=x....x (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Retrieve Configuration Status	N/A	All	65 bytes (MBT-4000B) 98 bytes (BDC), 76 bytes (BUC) alphanumeric	Query only. Used to Query the configuration status of the unit Example for MBT-4000B base: <pre><0001/RCS?{cr} >0001/RCS={cr} BF1=X {cr} BF2=X {cr} BT1=DN{cr} BT2=UP{cr} RED=0{cr} RAM=00{cr} MBT=N, A, or B EXT=0{cr}{lf}</pre> Example for BDC or BUC: <pre><0001A1/RCS?{cr} >0001A1/RCS={cr} FLO=06300{cr} ATT=01.00{cr} MUT=1{cr} SLP=0.3{cr} LCS=0{cr} LCW=99{cr} LFL=1{cr} REF=XXXX{cr} (reserved for future use) XRE=X{cr} (reserved for future use) AFR=0{cr}{lf}</pre> Note: for BUC, LCS, LCW, & LFL will not be shown.	N/A	RCS?	RCS=x....x (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Redundancy State	RED=x	MBT	1 byte, value of 0,1, or 2	Command or Query. Controls redundancy state. 0=Off 1=Enables redundancy using single base unit 2=Enables redundancy using dual base units Example: RED=1	RED= (message ok) RED? (received ok, but invalid arguments found) RED* (message ok, but not permitted in current mode)	RED?	RED=x (same format as command arguments)
Reference Oscillator Adjust	REF=xxxx	MBT	4 bytes, numeric	Command or Query. Ref Osc Adjust, between 0000 and 0255. Resolution 0001. Example: REF=0197 Note: REF cannot be adjusted when the unit is locked to an external reference source.	REF= (message ok) REF? (received ok, but invalid arguments found) REF* (message ok, but not permitted in current mode)	REF?	REF=xxxx (same format as command arguments)
Retrieve Equipment Type	N/A	All	22 bytes, alphanumeric	Query only. The unit returns a string indicated the Model Number and the software version installed Example: RET=BUC-4000 VER:1.0.3	N/A	RET?	RET=x...x (see description for details of arguments)
Enable Online/offline indicator line	EOM=xx	MBT	1 byte, value of 1,2	Command or Unit Unit Mode 1=Unit 1 0= letter "O", Aux Comm pin G as an output. 2=Unit 2 I= letter "I", Aux Comm pin G as an Input.	EOM=(message ok) EOM?(received ok, but invalid arguments found)	EOM?	EOM=xx (see description for details of arguments)
Invert EOM	IOM=xx	MBT	1 byte	Command or Query. The EOM command is used to establish pin G of Aux comm. 1 to provide Online/offline indication. This command established the logic level associated with the Online/offline indication Unit Mode 1=Unit 1 1=Invert 2=Unit 2 2=No Invert	IOM= (message ok) IOM? (received ok, but invalid arguments found)	IOM?	IOM=x...x (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Retrieve Maintenance Status	N/A	All	MBT-4000B - 103 bytes, alphanumeric BDC – 98 bytes, alphanumeric BUC – 98 bytes, alphanumeric	Query only. Used to Query the maintenance status of the unit. Example for MBT-4000B base: <0001/RMS?{cr} >0001/RMS={cr}{lf} 15VT1=015.1{cr} 7V5T1=007.7{cr} 5VLT1=005.0{cr} 28VT1=027.2{cr} REFVT=001.3{cr} LNA_1=000.0{cr} LNA_2=000.0{cr} RFSWP=B{cr} IFSWP=N{cr} RRFSW=B{cr} RIFSW=B{cr}{lf} Example for BUC: <0001A2/RMS={cr} >0001A2/RMS={cr}{lf} 15VT=015.1{cr} 7V5T=007.6{cr} 5VLT=005.2{cr} REFV=XXX.X{cr} (reserved for future use) SYNT=007.2{cr} POUT=XXX.X{cr} (reserved for future use) TEMP=+25.0{cr}{lf} Example for BDC: <0001A1/RMS={cr} >0001A1/RMS={cr}{lf} 15VT=015.1{cr} 7V5T=007.6{cr} 5VLT=005.2{cr} REFV=XXX.X{cr} (reserved for future use) SYNT=007.2{cr} LNAC=255.0{cr} TEMP=+25.0{cr}{lf} Note: "REFV" will show tuning voltage of reference OSC for standalone. Otherwise REFV=xxx.x which means Not Applicable.	N/A	RMS?	RMS=x....x (see description for details of arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Serial Number	N/A	All	9 bytes, numeric 000000000 to 999999999	Query only. Used to Query the units 9 digit serial number. Slave returns its S/N, in the form xxxxxxxxx. Example: RSN=000000165	N/A	RSN?	RSN=xxxxxxx x (see description for details of arguments)
Retrieve Utility Status	N/A	MBT	24 bytes alphanumeric	Query only. Used to Query the utility status of the MBT-4000B base unit.. Example: <0001/RUS={cr} >0001/RUS={cr}{lf} ADR=0001{cr} BDR=9600{cr}{lf}	N/A	RUS?	RUS=x....x (see description for details of arguments)
Remote Baud Rate	SBR=xxxx	MBT	4 bytes,	Command or Query. Set remote baud rate as follows: 9600 = 9600 baud 19K2 = 19200 baud	SBR= (message ok) SBR? (received ok, but invalid arguments found) SBR! (Command not accepted by BUC and BDC sub-units.)	SBR?	SBR=xxxx (same format as command arguments)
Summary Fault Status	N/A	All	N/A	Query only. Used to Query the status of the Summary Fault Relay. Where: 0=OK 1=FT Example: SFS?	N/A	SFS?	SFS=x (see description for details of arguments)
Remote Address	SPA=xxxx	MBT	4 byte, numeric	Command or Query. Set Physical Address-between 0001 to 9999. Resolution 0001 Example: SPA=0412	SPA= (message ok) SPA? (received ok, but invalid arguments found) SPA! (Command not accepted by BUC and BDC sub-units.)	SPA?	SPA=xxxx (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Slope Adjust	SSA=x.x	BDC BUC	3 bytes, numeric	Command or Query. Slope adjust level, valid from 0.0 to 1.0 with 0.1 resolution. Example: SSA=0.3	SSA= (message ok) SSA? (received ok, but invalid arguments found) SSA* (message ok, but not permitted in current mode) SSA! (command not accepted by MBT-4000B base unit. It must be addressed to BUC or BDC sub-units)	SSA?	SSA=x.x (same format as command arguments)
Set Redundancy Switch	SSW=xy	MBT	2 bytes	Command only. SSW control the switches dedicated to Slot1 or 2, and sets them to either Port A or Port B. Syntax: SSW=xy Where: X = 1 or 2 depicting Slot 1 or 2 Y = A or B depicting the switch direction. Direction A Switched to Converter on MBT_A B Switched to Converter on MBT_B	SSW=(message ok) SSW=xy	N/A	N/A
Set RTC Time	TIM=hhmmss	All	6 bytes, numeric	Command or Query. A command in the form hhmmss, indicating the time from midnight, Where: hh = hours, between 00 and 23 mm = minutes, between 00 and 59 ss = seconds, between 00 and 59 Example: TIM=231259 would be 23 hours, 12 minutes and 59 seconds from midnight.	TIM = (message ok) TIM? (received ok, but invalid arguments found) TIM * (message ok, but not permitted in current mode)	TIM?	TIM=hhmmss (same format as command arguments)

Parameter Type	Command (Instruction Code and qualifier)	Valid on MBT, BDC, or BUC	Arguments for Command or Response to Query	Description of arguments (Note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Instruction Code and qualifier)	Response to query (target to controller)
Retrieve Number of unread Stored Alarms	N/A	All	2 bytes, numeric	Query only. Returns the number of Stored Events, which remain unread, in the form xx. Example reply: TNA=18	N/A	TNA?	TNA=xx (see description for details of arguments)
Terminal Status change	N/A	All	1 byte, value of 0,1	Query only. Used to Query the status of the Terminal Status. Where: 0=no change in status 1=change in status Example: TSC=0	N/A	TSC?	TSC=x (see description for details of arguments)
External Reference Fault Logic	XRF=x	MBT	1 byte, value of 0,1	Command or Query. XRF controls whether or not the Software monitors the external reference source. If enabled and no source is present, a fault will be reported. 0=Ext Reference not monitored 1=Ext Reference is monitored and the lock state reported Example: XRF=1	XRF=(message ok) XRF?(received ok, but invalid arguments found)	XRF?	XRF=x (see description for details of arguments)

NOTES:

Appendix B. Faults/Events

There are three types of Faults/Events that may occur and be recorded in the event log of an MBT-4000B or BUC-4000. These are:

- Summary Faults
- Configurable Summary Faults
- Informational Events

Summary Faults indicate improper operation. When a Summary Fault condition occurs: The Summary Fault Relay will be de-energized. If a Summary Fault occurs on a converter, it will mute. If a Summary Fault occurs on the base unit, the applicable converters (one or both) will be muted according to the specific error. If a Summary Fault occurs on the on-line unit of a redundant pair, the off-line unit will detect the fault and assume on-line state. In all cases, a corresponding event message will be added to the event log.

Configurable Summary Faults operate the same as Summary Faults, except Configurable Summary Faults may be enabled/disabled via remote commands.

Informational Events are operation conditions, which may be important, but are not considered improper operation and will not cause a converter to mute.

Tables B1 through B5 list possible Fault/Event messages.

Table B-1. MBT-4000B Summary Faults

Mnemonic	Type	Mute	Description
15V PS1	Summary Fault	All	The 15 volt power supply is out of tolerance.
28V PS1	Summary Fault	All	The 28 volt power supply is out of tolerance.
5VT PS1	Summary Fault	All	The 5 volt power supply is out of tolerance.
7V5 PS1	Summary Fault	All	The 7.5 volt power supply is out of tolerance.
IIC BUS	Summary Fault	All	Unable to communication via the internal high speed communication bus

Table B-2. MBT-4000B Configurable Summary Faults

Mnemonic	Type	Mute	Description
AUXCOM1	Summary Fault – Configurable	Slot 1	The IO1A/FAULT input (AUX COMM 1) indicates a fault. Monitoring for this fault is enabled using the EAM command.
LNACUR2	Summary Fault - Configurable	Slot 2	The +17 V nominal bias tee provided LNB power supply current has exceeded the maximum limit of 450 mA and has been disabled. The LNB power supply—and thus this fault—is enabled using the LCS command. This fault is cleared by a LCS command or power cycle.
LNAWIN2	Summary Fault – Configurable	Slot 2	The +17 V nominal bias tee provided LNB power supply current is outside the programmed window. (The power supply is not disabled in response to this fault.). LNB current window monitoring is configured and enabled using the LCS, CLC and LCW commands. This fault is cleared by a LCS command, CLC command, LCW command or power cycle.
REF LD	Summary Fault – Configurable	All	The External Reference Monitor has lost lock with the external reference signal. All attached converters (UNIT 1 and UNIT 2) have been muted. Monitoring for this fault is enabled using the XRF command. This fault is cleared when lock has been regained.

Table B-3. MBT-4000B Informational Events

Mnemonic	Type	Mute	Description
LOG CLR	Informational Event	None	The Event LOG Queue was cleared in response to receipt of a CAA command.
PWR OFF	Informational Event	None	Power off was detected.
PWR ON	Informational Event	None	Power on was detected.

Table B-4. BUC-4000 Summary Faults

Mnemonic	Type	Description
15V SUP	Summary Fault	The 15 volt power supply is out of tolerance.
5VT SUP	Summary Fault	The 5 volt power supply is out of tolerance.
7V5 SUP	Summary Fault	The 7.5 volt power supply is out of tolerance.
OVR TMP	Summary Fault	The maximum operating temperature has been exceeded.
PLL LD	Summary Fault	The PLL has lost lock.

Table B-5. BUC-4000 Informational Events

Mnemonic	Type	Description
LOG CLR	Informational Event	The Event LOG Queue was cleared in response to receipt of a CAA command.
PWR OFF	Informational Event	Power off was detected.
PWR ON	Informational Event	Power on was detected.

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METRIC CONVERSIONS

Units of Length

Unit	Centimeter	Inch	Foot	Yard	Mile	Meter	Kilometer	Millimeter
1 centimeter	—	0.3937	0.03281	0.01094	6.214×10^{-6}	0.01	—	—
1 inch	2.540	—	0.08333	0.2778	1.578×10^{-5}	0.254	—	25.4
1 foot	30.480	12.0	—	0.3333	1.893×10^{-4}	0.3048	—	—
1 yard	91.44	36.0	3.0	—	5.679×10^{-4}	0.9144	—	—
1 meter	100.0	39.37	3.281	1.094	6.214×10^{-4}	—	—	—
1 mile	1.609×10^5	6.336×10^4	5.280×10^3	1.760×10^3	—	1.609×10^3	1.609	—
1 mm	—	0.03937	—	—	—	—	—	—
1 kilometer	—	—	—	—	0.621	—	—	—

Temperature Conversions

Unit	° Fahrenheit	° Centigrade
32° Fahrenheit	—	0 (water freezes)
212° Fahrenheit	—	100 (water boils)
-459.6° Fahrenheit	—	273.1 (absolute 0)

Formulas
$C = (F - 32) * 0.555$
$F = (C * 1.8) + 32$

Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoir.	Pound Troy	Kilogram
1 gram	—	0.03527	0.03215	0.002205	0.002679	0.001
1 oz. avoir.	28.35	—	0.9115	0.0625	0.07595	0.02835
1 oz. troy	31.10	1.097	—	0.06857	0.08333	0.03110
1 lb. avoir.	453.6	16.0	14.58	—	1.215	0.4536
1 lb. Troy	373.2	13.17	12.0	0.8229	—	0.3732
1 kilogram	1.0×10^3	35.27	32.15	2.205	2.679	—



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480 • 333 • 2200 PHONE
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